Worksheet 4 Thinking logically

Task 1

1. Use the trace table below to help you answer (a), (b) and (c) below.
   What would be the values of integer variables x, y and z after execution of these statements if the initial values of x and y are:

   (a) 2 and 7

   (b) -4 and -4

   (c) 27 and 3

```
z = x
IF x = y THEN
        x = x * x
        y = (x + y) / 2
    ELSE
        IF x < y THEN
            y = y * y
            z = y - x
        ELSE
            IF x > 0 THEN
                z = x/y
            ENDIF
        ENDIF
        y = 200
    ENDIF
    OUTPUT x, y, z
```

Trace

x	y	z

2. Use a trace table to determine the output from the following algorithm.

```
x = 5
k = 10
sum = 45
WHILE sum < 75
    sum = sum + k
    OUTPUT k
    k = k + x
ENDWHILE
OUTPUT sum
```

x	k	sum	OUTPUT

3. Study the following algorithm and fill in the trace tables below to discover what it does.

```
y = 2
z = 1
OUTPUT ("Please enter a positive integer: ")
x = USERINPUT
WHILE z<>0
      z = x mod y
       IF z <> 0 THEN
            y = y + 1
       ENDIF
ENDWHILE
IF x = y
   print (x, " is in category 1")
ELSE
   print (x, " is in category 2")
ENDIF
```

x	y	z

x	y	z

(i) If the user inputs the integer 25, what is output?

(ii) If the user enters the integer 7, what is output?

(iii) What are “category 1” and “category 2”? What is the purpose of the program?

(iv) Suggest ways in which the program could be made easier to understand.

(v) This is a "brute force" algorithm. Suggest how the algorithm could be made more efficient.

Task 2

4. Sean has written a program which contains a complex Boolean expression controlling a while loop.

(a) Complete the truth table for the Boolean expression:

```
while ((a > b) or (b > c)) and ((not (a > b)) and (not (b > c)))
```

Let P represent a > b and Q represent b > c

P	Q	not P	not Q	P or Q	Not P and not Q	(P or Q) and (not P and not Q)
False	False					
False	True					
True	False					
True	False					

(b) How many times will this loop be performed if a = 1, b = 2, c = 3?

How did you calculate your answer?

5. The programmer decides that the condition is not correct. He tries again.

```
while (a > b or b > c) or (not (a > b) and not (b > c))
```

Complete the truth table for this loop.

P	Q	not P	not Q	P or Q	Not P and not Q	(P or Q) or (not P and not Q)
False	False					
False	True					
True	False					

True	False					

How many times will this loop be performed if a = 1, b = 2, c = 3?

Task 3

6. An Internet site has the following login procedure. To access their account, a customer has to enter

   - a 10-character user ID (3 attempts allowed)
   - a 4-digit PIN (1 attempt allowed)
   - three random characters from their password (3 attempts allowed)

   Once the user enters their user ID, a subroutine is called which looks up their record and reads the stored userID, PIN and password.

   If the user fails after 3 attempts to enter an ID which is held in the record, a message is displayed “Incorrect ID – access denied”

   Similar messages are displayed if the user fails to enter a correct PIN or password

   If all details are correct, access to the account is permitted.

   (a) Draw a hierarchy chart to show the tasks and subtasks involved in the login procedure.

   (b) Write pseudocode for a subroutine to check that the user ID exists on a customer file.

   (c) What are the weaknesses in this login procedure? What improvements would you suggest?

Task 4

7. Look up “Benefits of quad-core processor” in a search engine and list some of the benefits and applications which commonly use parallel processing.